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Department of
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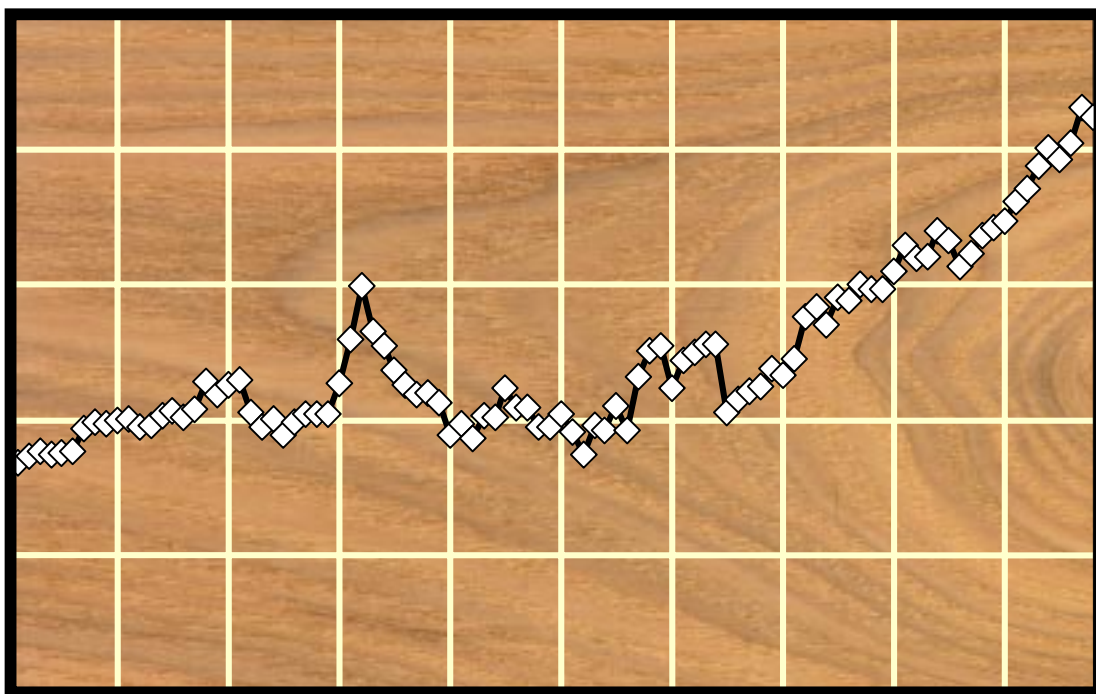
Forest
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FPL–RN–0272



Industrial Wood Productivity in the United States, 1900–1998

Peter J. Ince



Abstract

The productivity of U.S. wood and paper product output in terms of wood input is computed and displayed in graphs. Background tables provide supporting data. The productivity trend parallels trends in the recovered paper utilization rate. Recycling and wood residue use are key factors in productivity gains.

Keywords: forest products, wood use, efficiency

March 2000

Ince, Peter J. 2000. Industrial wood productivity in the United States, 1900–1998. Res. Note FPL–RN–0272. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 14 p.

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Industrial Wood Productivity in the United States, 1900–1998

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Industrial Wood Productivity

The productivity of industrial wood use in the United States is indicated by the quantity (e.g., tons) of industrial wood product output produced per unit (e.g., ton) of industrial roundwood input. Industrial wood productivity increased in the United States by 39% from 1900 to 1998. The historical trend shown in Figure 1 is derived from data in Tables 1 to 3 (conversion factor assumptions are specified in Table 4). Industrial roundwood input is the estimated amount of timber harvested for the manufacture of industrial wood products. Industrial wood products exclude fuelwood (shown separately in Table 1) but include all manufactured wood products produced in the U.S. economy. Industrial wood productivity increased most rapidly since around 1950 due to gains in the use of wood residues and recycled wood fiber. The gain in industrial wood productivity reveals that more industrial wood products are being produced from a given volume of timber harvested. The same trend can be shown in terms of pounds of industrial wood product output per cubic foot of industrial roundwood input (Fig. 2).

Why Has Industrial Wood Productivity Increased?

Most of this century's gains in industrial wood productivity occurred since 1950 and were the result of gains in use of wood residues and in paper recycling. These two developments played sequential roles in industrial wood productivity gains. Large increases in wood residue use fostered improved wood productivity from the 1950s to the 1980s (chips, slabs, edgings, and planer shavings from sawmills and planer mills were used increasingly in the manufacture of woodpulp and particleboard, with a greater than ten-fold increase in residue use from 1950 to 1985). Subsequently, much of the further gains in wood productivity occurred as a result of increased paper recycling (since the mid-1980s). Overlapping trends (Fig. 3) reflect a correlation between recovered paper utilization rate and industrial wood productivity since the 1980s

(corresponding to a period when large gains were made in paper recycling, and coincidentally corresponding to a period when increases in residue use tapered off with nearly full utilization of available wood residues).

Why Are Gains in Industrial Wood Productivity Important?

Gains in industrial wood productivity mean that proportionately more useful wood products are being produced from the trees that are harvested for wood products (industrial roundwood). Figures 4 and 5 show historical trends in total and per capita U.S. industrial wood product output. Industrial wood product output approximately doubled between the late 1950s and 1998, and per capita production has been increasing. These growth trends reinforce the importance of monitoring industrial wood productivity. Fifty years ago, the total industrial wood product output of the United States was equivalent to only about 70% of industrial timber harvest on a weight basis. Today, the U.S. industrial wood product output is approaching 95% of industrial timber harvest because of productivity gains associated with increased use of wood residues and increased recycling of wood fiber. It can be noted that some wood and most bark is consumed for energy in production processes, and not all the weight of product output consists of wood or wood fiber. Some of the product weight consists of other materials such as coatings for paper and adhesives for plywood, oriented strandboard, particleboard, medium-density fiberboard, hardboard, and insulation board. While a variety of factors have contributed to gains in industrial wood productivity, the use of wood residues and paper recycling account for most of the gains in product output per unit of roundwood input. In the future, increased use of recycled fiber and other composite materials in wood products may allow the tonnage of industrial wood product output per ton of roundwood input to exceed a ratio of 1:1. Recycling allows wood and wood fiber to be used more than once in making wood products.

Recycling and Industrial Wood Productivity

The recovered paper utilization rate is the ratio of the tonnage of recycled paper used domestically in manufacture of paper and paperboard to the tonnage of paper and paperboard produced domestically in the United States. The utilization rate has increased significantly since the late 1980s, reflecting favorable market conditions of abundant recovered paper supply, stimulated by expansion of voluntary and mandated recycling programs of private sector and governmental organizations. Gains in the recovered paper utilization rate help extend the amount of paper and paperboard products that can be produced with each unit of pulpwood input.

Indicators of trends in wood productivity and recycling change slowly over time, but their cumulative effect is apparent in looking at data that span many decades. The industrial wood productivity of the United States has varied in part with annual changes in economic conditions, such as with a significant shift in product output during the Great Depression of the 1930s. However, it is observed that industrial wood productivity has generally increased since the 1950s. The industrial wood productivity measure (tons of product output per ton of industrial roundwood input, Fig. 1) is useful as a rough measure of wood productivity gains—actual weight of product outputs can vary because of subtle changes in product mix that are not reflected in these national level estimates.

In the future, the recovered paper utilization rate will likely continue to increase more slowly and is expected to reach a maximum of around 40% within the next decade. Pushing the recovered paper utilization rate much higher than 40% is believed by many to be unlikely under current economic conditions, because some paper products are unrecoverable, some recovered paper is exported, some fiber loss occurs in recycling, and there are costs associated with using higher proportions of lower quality recycled paper. However, technological developments may foster increased use of recycled wood and wood fiber in other wood products.

Data Sources

Data on industrial roundwood input were derived from data on industrial wood product production from various trade associations and from Forest Service estimates of timber use by major product, as discussed in the footnotes to the tables.

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This summary and the data spreadsheet files are available on the USDA Forest Service, Forest Products Laboratory, website (www.fpl.fs.fed.us) or from Peter J. Ince, USDA Forest Service, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705–2398, 608–231–9364.

Table 1—U.S. annual industrial wood product production (and fuelwood production) in conventional units of measure^a

Year	Softwood plywood (million ft ² , 3/8 in.)	OSB/wafer- board (million ft ² , 3/8 in.)	Laminated veneer lumber (million ft ³)	Hardwood plywood and veneer (million ft ² , 3/8 in.)	Softwood lumber (million bd. ft.)	Hardwood lumber (million bd. ft.)	Lumber made at pallet plants (million bd. ft.)	Particle- board production (million ft ² , 3/4 in.)	Hardboard production (million ft ² , 1/8 in.)	MDF production (million ft ² , 3/4 in.)	Pulp, paper, and board (thousand tons)	Other industrial products (million ft ³)	Insulating board (million ft ² , 1/2 in.)	Fuelwood ^b (million ft ³)
1900	0	0	0	23	26,372	8,706	N.A.	0	0	0	2,168	1,460	0	4,800
1901	0	0	0	23	27,914	9,291	N.A.	0	0	0	2,403	1,490	0	4,650
1902	0	0	0	46	29,455	9,877	N.A.	0	0	0	2,638	1,525	0	4,500
1903	0	0	0	69	30,997	10,462	N.A.	0	0	0	2,872	1,575	0	4,350
1904	0	0	0	92	32,538	10,462	N.A.	0	0	0	3,107	1,600	0	4,200
1905	0	0	0	162	32,960	10,540	N.A.	0	0	0	3,310	1,640	0	4,050
1906	0	0	0	277	34,900	11,100	N.A.	0	0	0	3,513	1,800	0	3,900
1907	0	0	0	300	34,946	11,054	N.A.	0	0	0	3,715	2,110	0	3,825
1908	0	0	0	323	31,945	10,055	N.A.	0	0	0	3,918	1,930	0	3,975
1909	0	0	0	370	33,896	10,613	N.A.	0	0	0	4,121	2,050	0	3,825
1910	N.A.	0	0	416	34,029	10,471	N.A.	0	0	0	4,327	2,075	0	3,910
1911	N.A.	0	0	370	33,020	9,980	N.A.	0	0	0	4,534	2,020	0	4,035
1912	N.A.	0	0	370	34,695	10,305	N.A.	0	0	0	4,740	2,015	0	3,760
1913	N.A.	0	0	370	34,065	9,935	N.A.	0	0	0	4,947	1,995	0	3,780
1914	N.A.	0	0	393	31,481	9,019	N.A.	0	0	0	5,153	1,925	0	3,975
1915	N.A.	0	0	393	29,485	7,527	N.A.	0	0	0	5,370	1,885	0	3,975
1916	N.A.	0	0	416	31,332	8,475	N.A.	0	5	0	5,587	1,930	0	3,955
1917	N.A.	0	0	416	29,174	6,657	N.A.	0	10	0	5,804	1,930	0	4,040
1918	N.A.	0	0	439	25,667	6,223	N.A.	0	15	0	5,938	1,920	0	4,290
1919	N.A.	0	0	485	27,407	7,145	N.A.	0	20	0	5,966	1,915	0	4,075
1920	77	0	0	370	27,610	7,390	N.A.	0	25	0	7,185	1,890	0	4,065
1921	92	0	0	347	23,444	5,556	N.A.	0	30	0	5,333	1,720	0	4,270
1922	107	0	0	416	28,922	6,328	N.A.	0	35	0	6,875	1,695	0	3,760
1923	122	0	0	531	33,220	7,780	N.A.	0	40	0	7,871	1,705	0	3,375
1924	137	0	0	531	31,549	7,951	N.A.	0	45	0	7,930	1,655	0	3,380
1925	153	0	0	624	33,284	7,716	N.A.	0	48	0	9,002	1,495	88	3,225
1926	176	0	0	670	32,078	7,672	N.A.	0	66	0	9,794	1,490	121	3,065
1927	199	0	0	809	29,975	7,275	N.A.	0	67	0	10,002	1,435	123	3,200
1928	221	0	0	809	29,852	6,898	N.A.	0	76	0	10,403	1,385	140	3,225
1929	358	0	0	924	30,836	7,909	N.A.	0	134	0	11,140	1,380	247	3,170
1930	305	0	0	716	23,228	6,130	N.A.	0	116	0	10,169	1,195	214	3,790
1931	235	0	0	578	15,886	4,111	N.A.	0	105	0	9,382	970	193	4,390
1932	313	0	0	555	10,802	2,722	N.A.	0	58	0	7,998	830	107	4,980
1933	390	0	0	578	13,786	3,365	N.A.	0	54	0	9,190	835	100	5,005
1934	435	0	0	601	14,618	4,208	N.A.	0	64	0	9,187	855	117	4,825
1935	480	0	0	670	18,196	4,748	N.A.	0	75	0	10,479	895	138	4,510
1936	700	0	0	762	22,025	5,601	N.A.	0	92	0	11,976	975	169	4,265
1937	725	0	0	854	23,148	5,856	N.A.	0	103	0	12,837	1,020	190	4,075
1938	650	0	0	946	19,955	4,870	N.A.	0	111	0	11,381	920	204	4,325
1939	1,032	0	0	1,038	23,291	5,464	N.A.	0	108	0	13,510	965	199	4,190
1940	1,150	0	0	1,130	25,622	5,537	N.A.	0	168	0	14,484	965	309	3,890

Table 1—U.S. annual industrial wood product production (and fuelwood production) in conventional units of measure^a—con.

Year	Softwood plywood (million ft ² , 3/8 in.)	OSB/wafer- board (million ft ² , 3/8 in.)	Laminated veneer lumber (million ft ³)	Hardwood plywood and veneer (million ft ² , 3/8 in.)	Softwood lumber (million bd. ft.)	Hardwood lumber (million bd. ft.)	Lumber made at pallet plants (million bd. ft.)	Particle- board production (million ft ² , 3/4 in.)	Hardboard production (million ft ² , 1/8 in.)	MDF production (million ft ² , 3/4 in.)	Pulp, paper, and board (thousand tons)	Other industrial products (million ft ³)	Insulating board (million ft ² , 1/2 in.)	Fuelwood ^b (million ft ³)
1941	1,600	0	0	1,222	29,867	6,671	N.A.	0	589	0	17,762	1,030	1,086	3,595
1942	1,840	0	0	1,314	29,510	6,822	N.A.	0	760	0	17,084	1,000	1,514	2,865
1943	1,440	0	0	1,261	26,917	7,372	N.A.	0	831	0	17,036	920	1,532	2,785
1944	1,440	0	0	1,261	25,160	7,778	N.A.	0	790	0	17,183	905	1,585	2,915
1945	1,222	0	0	1,156	21,140	6,982	N.A.	0	731	0	17,371	845	1,564	2,975
1946	1,200	0	0	1,163	25,856	8,256	N.A.	0	790	0	19,278	890	1,685	2,675
1947	1,700	0	0	1,170	27,937	7,467	N.A.	0	849	0	21,114	940	1,851	2,685
1948	1,787	0	0	1,177	29,600	7,400	N.A.	0	1,026	0	21,897	850	2,193	2,665
1949	1,873	0	0	1,183	26,472	5,704	N.A.	N.A.	610	0	20,098	745	1,449	2,820
1950	2,676	0	0	1,190	30,633	7,374	N.A.	21	1,076	0	24,375	770	2,108	2,270
1951	2,995	0	0	1,197	29,493	7,711	N.A.	30	978	0	26,048	730	2,186	2,230
1952	3,178	0	0	1,224	30,234	7,228	N.A.	33	1,152	0	24,423	700	2,260	2,025
1953	3,848	0	0	1,228	29,615	7,180	N.A.	42	1,189	0	26,567	750	2,372	1,950
1954	3,989	0	0	1,116	29,283	7,074	N.A.	48	1,307	0	26,411	740	2,543	1,800
1955	5,284	0	0	1,355	29,815	7,565	N.A.	70	1,489	0	30,154	780	2,814	1,725
1956	5,432	0	0	1,347	30,129	7,968	N.A.	111	1,517	0	31,428	730	2,835	1,650
1957	5,653	0	0	1,177	27,100	7,437	N.A.	183	1,599	0	30,666	680	2,690	1,575
1958	6,487	0	0	1,151	27,379	7,689	N.A.	250	1,711	0	30,823	670	2,877	1,495
1959	7,736	0	0	1,346	30,509	8,533	N.A.	255	2,063	0	33,748	730	3,289	1,500
1960	7,759	0	0	1,102	26,672	7,999	N.A.	232	1,930	0	33,758	510	2,848	1,300
1961	8,496	0	0	1,305	26,066	7,610	N.A.	291	2,154	0	34,937	490	2,850	1,215
1962	9,315	0	0	1,516	26,819	8,127	N.A.	366	2,445	0	36,678	465	2,885	1,125
1963	10,375	0	0	1,683	27,552	9,137	N.A.	456	2,709	0	38,272	515	3,039	1,055
1964	11,455	0	0	1,912	29,284	9,298	N.A.	592	2,689	0	40,961	540	3,262	985
1965	12,447	0	0	2,049	29,295	9,431	92	753	2,921	75	43,465	560	3,362	915
1966	13,056	0	0	2,076	28,847	9,771	109	948	3,083	83	46,971	565	3,079	845
1967	12,958	0	0	1,916	28,172	9,311	110	1,074	3,038	93	46,969	515	3,209	780
1968	14,695	0	0	2,009	29,285	8,432	121	1,391	3,710	103	50,561	485	3,476	700
1969	13,694	0	0	1,869	28,342	7,849	140	1,682	4,247	114	53,530	455	3,623	620
1970	14,340	0	N.A.	1,796	27,530	7,701	133	1,731	4,384	127	53,408	425	3,194	535
1971	16,635	0	N.A.	1,924	30,039	8,106	145	2,359	5,225	141	53,753	415	3,839	500
1972	18,324	0	N.A.	2,030	30,975	8,230	163	3,079	5,798	157	58,009	405	3,918	475
1973	18,305	0	N.A.	1,807	31,586	8,792	195	3,460	6,050	174	60,548	405	3,914	505
1974	15,878	0	N.A.	1,401	27,704	8,448	216	3,075	5,654	194	60,403	395	3,282	535
1975	16,050	0	N.A.	1,052	26,747	7,304	167	2,503	5,681	215	52,393	385	2,960	570
1976	18,440	0	N.A.	1,083	29,693	7,978	206	3,189	6,785	280	59,283	375	3,407	600
1977	19,376	0	N.A.	1,187	31,737	8,500	248	3,569	7,714	441	61,149	385	3,462	1,000
1978	19,964	0	N.A.	1,185	32,057	8,728	284	3,720	7,825	508	63,085	395	3,437	1,525
1979	19,653	0	N.A.	1,150	31,432	9,069	311	3,376	7,688	507	65,873	405	3,310	2,205
1980	16,333	135	3	1,038	26,246	8,860	271	2,950	6,140	493	66,217	415	2,780	3,105

Table 1—U.S. annual industrial wood product production (and fuelwood production) in conventional units of measure^a—con.

Year	Softwood plywood (million ft ² , 3/8 in.)	OSB/wafer- board (million ft ² , 3/8 in.)	Laminated veneer lumber (million ft ³)	Hardwood plywood and veneer (million ft ² , 3/8 in.)	Softwood lumber (million bd. ft.)	Hardwood lumber (million bd. ft.)	Lumber made at pallet plants (million bd. ft.)	Particle- board production (million ft ² , 3/4 in.)	Hardboard production (million ft ² , 1/8 in.)	MDF production (million ft ² , 3/4 in.)	Pulp, paper, and board (thousand tons)	Other industrial products (million ft ³)	Insulating board (million ft ² , 1/2 in.)	Fuelwood ^b (million ft ³)
1981	16,752	271	4	976	24,676	7,147	265	2,869	6,105	516	66,931	425	2,124	3,180
1982	15,846	557	4	1,385	23,787	7,668	240	2,393	5,587	446	63,483	435	1,790	3,355
1983	19,480	1,341	5	1,480	29,726	8,556	270	3,009	7,303	604	69,352	445	2,277	3,235
1984	19,926	2,042	5	1,505	31,174	9,865	300	3,196	6,837	634	72,742	455	2,545	3,620
1985	20,169	2,669	7	1,342	31,321	8,866	330	3,331	6,300	685	71,459	465	2,461	3,450
1986	22,118	3,513	8	1,390	35,273	10,877	360	3,603	5,822	781	75,964	475	2,194	3,096
1987	22,899	4,076	10	1,524	38,235	11,695	360	3,706	5,458	899	79,830	495	2,242	3,076
1988	22,599	4,604	11	1,552	38,130	12,170	360	3,829	5,118	939	82,847	510	2,340	3,066
1989	21,385	5,105	12	1,541	37,545	12,415	366	3,858	5,196	970	83,257	489	2,455	3,041
1990	20,919	5,418	16	1,537	35,791	12,660	366	3,806	5,025	950	85,307	468	2,365	3,019
1991	18,652	5,613	16	1,482	33,161	11,633	372	3,772	4,895	958	86,546	447	2,323	3,028
1992	19,332	6,653	17	1,393	34,526	11,639	372	3,980	5,273	1,066	90,885	425	2,363	3,044
1993	19,315	7,002	21	1,449	32,947	11,914	372	4,241	5,248	1,161	92,154	404	2,358	3,084
1994	19,638	7,486	23	1,698	34,107	12,311	384	4,542	5,206	1,251	96,595	383	2,335	3,134
1995	19,367	7,903	28	1,700	32,233	12,434	396	4,267	4,930	1,145	98,582	362	2,335	2,937
1996	19,181	9,314	32	1,683	33,266	12,705	394	4,459	5,280	1,246	98,334	341	2,335	2,739
1997	17,963	10,534	38	1,680	34,667	13,000	377	4,531	4,501	1,385	102,822	341	2,335	2,542
1998	17,776	11,227	41	1,680	34,677	13,500	365	5,000	5,000	1,450	101,262	341	2,335	2,300

^aSources for recent production data (some earlier data are Forest Service estimates derived from trade associations or from Department of Commerce):

Softwood plywood, OSB, and LVL production data (1960–1998) from APA—The Engineered Wood Association (APA 1999).

Hardwood plywood production data from U.S. Department of Commerce (to 1988); 1989–1990 data from Hardwood Plywood & Veneer Association; later estimates based on trends in value of shipments (U.S. Department of Commerce); hardwood veneer based on Census of Manufactures data and trend in value of shipments.

Lumber production 1900–1946 based on Steer (1948, Table 1, "Estimated Production"). Note: Estimated production is higher than "reported production".

Lumber production 1947–1976 based on U.S. Department of Commerce data and Forest Service estimates. Lumber production 1976–1998 from American Forest & Paper Association (AF&PA 1999a). 1996 hardwood estimated by Forest Service; 1997–1998 hardwood estimate from Miller Freeman (1998). Note that U.S. Department of Commerce reported hardwood lumber production is understood to underestimate actual production as reflected in Forest Service estimates since 1900.

"Lumber made at pallet plants" is a Forest Service estimate of lumber cut from roundwood at pallet plants. Other lumber (e.g., purchased lumber) used by pallet makers is accounted for under hardwood and softwood lumber production.

Particleboard and MDF production data from Composite Panel Association (based on production data 1959–1977 and 1995–1997; otherwise based on shipments; 1998 data are estimated).

Hardboard production based on shipments data from American Hardboard Association (1964–997) and as reported by Miller Freeman (1998); 1998 figure is estimated.

Pulp, paper, and paperboard production data are from American Forest & Paper Association (AF&PA 1999b). Paper and paperboard production includes "Total Paper", "Total Paperboard", and "Building Paper" production. Total production of pulp, paper, and paperboard includes market pulp produced for export.

Miscellaneous wood product production data through 1988 obtained from U.S. Timber Production, Trade, Consumption, and Price Statistics reports (Howard 1999, Ulrich 1985). Miscellaneous wood product production for 1996 based on timber product output tables in draft 1997 RPA Inventory Data Tables; intervening and subsequent data are extrapolated.

Insulating board production data are derived using earlier data from U.S. Department of Commerce MA26A reports (in square feet of product output) to convert tonnage reported in AF&PA and earlier API reports (Statistics of Paper, Paperboard and Woodpulp) (AF&PA 1999b).

^bFuelwood estimates are shown for comparison only and are not included in industrial wood products. Fuelwood data are Forest Service estimates (Skog and others, unpublished FPL estimates).

Table 2—U.S. annual industrial wood product production in thousands of short tons, product weight^a

Year	Softwood plywood	OSB/wafer- board	Laminated veneer lumber	Hardwood plywood and veneer	Softwood lumber	Hardwood lumber	Lumber made at pallet plants	Particle- board production	Hardboard production	MDF production	Pulp, paper, and board	Other industrial products	Insulating board
1900	0	0	0	15	25,746	14,691	0	0	0	0	2,168	24,090	0
1901	0	0	0	15	27,251	15,679	0	0	0	0	2,403	24,585	0
1902	0	0	0	30	28,755	16,667	0	0	0	0	2,638	25,163	0
1903	0	0	0	45	30,260	17,655	0	0	0	0	2,872	25,988	0
1904	0	0	0	61	31,765	17,655	0	0	0	0	3,107	26,400	0
1905	0	0	0	106	32,177	17,786	0	0	0	0	3,310	27,060	0
1906	0	0	0	182	34,071	18,731	0	0	0	0	3,513	29,700	0
1907	0	0	0	197	34,116	18,654	0	0	0	0	3,715	34,815	0
1908	0	0	0	212	31,186	16,968	0	0	0	0	3,918	31,845	0
1909	0	0	0	243	33,091	17,909	0	0	0	0	4,121	33,825	0
1910	0	0	0	273	33,221	17,670	0	0	0	0	4,327	34,238	0
1911	0	0	0	243	32,236	16,841	0	0	0	0	4,534	33,330	0
1912	0	0	0	243	33,871	17,390	0	0	0	0	4,740	33,248	0
1913	0	0	0	243	33,256	16,765	0	0	0	0	4,947	32,918	0
1914	0	0	0	258	30,733	15,220	0	0	0	0	5,153	31,763	0
1915	0	0	0	258	28,785	12,702	0	0	0	0	5,370	31,103	0
1916	0	0	0	273	30,588	14,302	0	0	2	0	5,587	31,845	0
1917	0	0	0	273	28,481	11,234	0	0	3	0	5,804	31,845	0
1918	0	0	0	288	25,057	10,501	0	0	5	0	5,938	31,680	0
1919	0	0	0	318	26,756	12,057	0	0	6	0	5,966	31,598	0
1920	42	0	0	243	26,954	12,471	0	0	8	0	7,185	31,185	0
1921	50	0	0	227	22,887	9,376	0	0	9	0	5,333	28,380	0
1922	58	0	0	273	28,235	10,679	0	0	11	0	6,875	27,968	0
1923	67	0	0	349	32,431	13,129	0	0	13	0	7,871	28,133	0
1924	75	0	0	349	30,800	13,417	0	0	14	0	7,930	27,308	0
1925	84	0	0	409	32,494	13,021	0	0	15	0	9,002	24,668	32
1926	96	0	0	440	31,316	12,947	0	0	20	0	9,794	24,585	44
1927	109	0	0	531	29,263	12,277	0	0	21	0	10,002	23,678	45
1928	121	0	0	531	29,143	11,640	0	0	24	0	10,403	22,853	51
1929	196	0	0	607	30,104	13,346	0	0	42	0	11,140	22,770	91
1930	167	0	0	470	22,676	10,344	0	0	36	0	10,169	19,718	79
1931	129	0	0	379	15,509	6,937	0	0	33	0	9,382	16,005	71
1932	171	0	0	364	10,545	4,593	0	0	18	0	7,998	13,695	39
1933	213	0	0	379	13,459	5,678	0	0	17	0	9,190	13,778	37
1934	238	0	0	394	14,271	7,101	0	0	20	0	9,187	14,108	43
1935	263	0	0	440	17,764	8,012	0	0	23	0	10,479	14,768	51
1936	383	0	0	500	21,502	9,452	0	0	29	0	11,976	16,088	62
1937	396	0	0	560	22,598	9,882	0	0	32	0	12,837	16,830	70
1938	355	0	0	621	19,481	8,218	0	0	35	0	11,381	15,180	75
1939	564	0	0	681	22,738	9,221	0	0	34	0	13,510	15,923	73
1940	629	0	0	742	25,013	9,344	0	0	52	0	14,484	15,923	113

Table 2—U.S. annual industrial wood product production in thousands of short tons, product weight^a—con.

Year	Softwood plywood	OSB/wafer- board	Laminated veneer lumber	Hardwood plywood and veneer	Softwood lumber	Hardwood lumber	Lumber made at pallet plants	Particle- board production	Hardboard production	MDF production	Pulp, paper, and board	Other industrial products	Insulating board
1941	875	0	0	802	29,158	11,257	0	0	184	0	17,762	16,995	399
1942	1,006	0	0	862	28,809	11,512	0	0	237	0	17,084	16,500	556
1943	788	0	0	828	26,278	12,440	0	0	260	0	17,036	15,180	562
1944	788	0	0	793	24,562	13,125	0	0	247	0	17,183	14,933	582
1945	668	0	0	759	20,638	11,782	0	0	228	0	17,371	13,943	574
1946	656	0	0	763	25,242	13,932	0	0	247	0	19,278	14,685	619
1947	930	0	0	768	27,273	12,601	0	0	265	0	21,114	15,510	680
1948	977	0	0	772	28,897	12,488	0	0	321	0	21,897	14,025	805
1949	1,024	0	0	777	25,843	9,626	0	0	191	0	20,098	12,293	532
1950	1,463	0	0	781	29,905	12,444	0	30	336	0	24,375	12,705	774
1951	1,638	0	0	786	28,793	13,012	0	42	306	0	26,048	12,045	803
1952	1,738	0	0	803	29,516	12,197	0	46	360	0	24,423	11,550	830
1953	2,104	0	0	806	28,912	12,116	0	59	371	0	26,567	12,375	871
1954	2,181	0	0	732	28,588	11,937	0	68	408	0	26,411	12,210	934
1955	2,890	0	0	889	29,107	12,766	0	98	465	0	30,154	12,870	1,033
1956	2,971	0	0	884	29,413	13,446	0	156	474	0	31,428	12,045	1,041
1957	3,091	0	0	772	26,456	12,550	0	257	500	0	30,666	11,220	988
1958	3,548	0	0	755	26,729	12,975	0	352	535	0	30,823	11,055	1,056
1959	4,231	0	0	883	29,784	14,399	0	359	645	0	33,748	12,045	1,208
1960	4,243	0	0	723	26,039	13,498	0	326	603	0	33,758	8,415	1,046
1961	4,646	0	0	856	25,447	12,842	0	410	673	0	34,937	8,085	1,046
1962	5,094	0	0	995	26,182	13,714	0	515	764	0	36,678	7,673	1,059
1963	5,674	0	0	1,104	26,898	15,419	0	641	847	0	38,272	8,498	1,116
1964	6,264	0	0	1,255	28,589	15,690	0	832	840	0	40,961	8,910	1,198
1965	6,807	0	0	1,345	28,599	15,915	153	1,059	913	105	43,465	9,240	1,234
1966	7,140	0	0	1,362	28,162	16,489	182	1,333	963	117	46,971	9,323	1,131
1967	7,086	0	0	1,257	27,503	15,712	183	1,510	949	131	46,969	8,498	1,178
1968	8,036	0	0	1,318	28,589	14,229	202	1,956	1,159	145	50,561	8,003	1,276
1969	7,489	0	0	1,227	27,669	13,245	233	2,365	1,327	160	53,530	7,508	1,330
1970	7,842	0	0	1,179	26,876	12,995	222	2,434	1,370	179	53,408	7,013	1,173
1971	9,097	0	0	1,263	29,326	13,679	242	3,317	1,633	198	53,753	6,848	1,410
1972	10,021	0	0	1,332	30,239	13,888	272	4,330	1,812	221	58,009	6,683	1,439
1973	10,011	0	0	1,186	30,836	14,837	325	4,866	1,891	245	60,548	6,683	1,437
1974	8,683	0	0	919	27,046	14,256	360	4,324	1,767	273	60,403	6,518	1,205
1975	8,777	0	0	690	26,112	12,326	278	3,520	1,775	302	52,393	6,353	1,087
1976	10,084	0	0	711	28,988	13,463	343	4,485	2,120	394	59,283	6,188	1,251
1977	10,596	0	0	779	30,983	14,344	413	5,019	2,411	620	61,149	6,353	1,271
1978	10,918	0	0	778	31,296	14,729	473	5,231	2,445	714	63,085	6,518	1,262
1979	10,748	0	0	755	30,685	15,304	518	4,748	2,403	713	65,873	6,683	1,215
1980	8,932	84	53	681	25,623	14,951	452	4,148	1,919	693	66,217	6,848	1,021

Table 2—U.S. annual industrial wood product production in thousands of short tons, product weight^a—con.

Year	Softwood plywood	OSB/wafer- board	Laminated veneer lumber	Hardwood plywood and veneer	Softwood lumber	Hardwood lumber	Lumber made at pallet plants	Particle- board production	Hardboard production	MDF production	Pulp, paper, and board	Other industrial products	Insulating board
1981	9,161	169	70	641	24,090	12,061	442	4,035	1,908	726	66,931	7,013	780
1982	8,666	348	70	909	23,222	12,940	400	3,365	1,746	627	63,483	7,178	657
1983	10,653	838	88	971	29,020	14,438	450	4,231	2,282	849	69,352	7,343	836
1984	10,897	1,276	88	988	30,434	16,647	500	4,494	2,137	892	72,742	7,508	934
1985	11,030	1,668	123	881	30,577	14,961	550	4,684	1,969	963	71,459	7,673	904
1986	12,096	2,196	140	912	34,435	18,355	600	5,067	1,819	1,098	75,964	7,838	806
1987	12,523	2,548	175	1,000	37,327	19,735	600	5,212	1,706	1,264	79,830	8,168	823
1988	12,359	2,878	193	1,019	37,224	20,537	600	5,385	1,599	1,320	82,847	8,415	859
1989	11,695	3,191	210	1,011	36,653	20,950	610	5,425	1,624	1,364	83,257	8,069	901
1990	11,440	3,386	280	1,009	34,941	21,364	610	5,352	1,570	1,336	85,307	7,722	868
1991	10,200	3,508	280	973	32,373	19,631	620	5,304	1,530	1,347	86,546	7,376	853
1992	10,572	4,158	298	914	33,706	19,641	620	5,597	1,648	1,499	90,885	7,013	868
1993	10,563	4,376	368	951	32,165	20,105	620	5,964	1,640	1,633	92,154	6,666	866
1994	10,740	4,679	403	1,114	33,297	20,775	640	6,387	1,627	1,759	96,595	6,320	857
1995	10,591	4,939	490	1,116	31,467	20,982	660	6,000	1,541	1,610	98,582	5,973	857
1996	10,490	5,821	560	1,104	32,476	21,440	657	6,270	1,650	1,752	98,334	5,627	857
1997	9,824	6,584	665	1,103	33,844	21,938	628	6,372	1,407	1,948	102,822	5,627	857
1998	9,721	7,017	718	1,103	33,853	22,781	608	7,031	1,563	2,039	101,262	5,627	857

^aValues converted from Table 1 using conversion factors in Table 4.

Table 3—Total production, productivity, recovered paper utilization, and per capita production^a

Year	Total industrial wood product production (thousand tons)	Roundwood equivalents of production ^b					Industrial wood productivity (industrial wood product output per unit of roundwood input) (lb/ft ³) (tons/ton)		Recovered paper utilization rate ^c	U.S. population (millions)	Per capita industrial wood product production (lb/capita)
		Hardwoods (million ft ³)	Softwoods (million ft ³)	Total							
				(million ft ³)	(thousand short tons)	(thousand metric tons)					
1900	66,710	N.A.	N.A.	7,285	100,533	91,202	18.31	0.6636	N.A.	76.4	1,746
1901	69,933	N.A.	N.A.	7,580	104,604	94,895	18.45	0.6685	N.A.	77.9	1,795
1902	73,253	N.A.	N.A.	7,880	108,744	98,650	18.59	0.6736	N.A.	79.4	1,845
1903	76,820	N.A.	N.A.	8,215	113,367	102,844	18.70	0.6776	N.A.	80.9	1,899
1904	78,987	N.A.	N.A.	8,490	117,162	106,287	18.61	0.6742	N.A.	82.5	1,915
1905	80,439	N.A.	N.A.	8,625	119,025	107,977	18.65	0.6758	N.A.	84.0	1,915
1906	86,197	N.A.	N.A.	9,225	127,305	115,489	18.69	0.6771	N.A.	85.5	2,016
1907	91,497	N.A.	N.A.	9,555	131,859	119,620	19.15	0.6939	N.A.	87.0	2,103
1908	84,130	N.A.	N.A.	8,725	120,405	109,229	19.28	0.6987	N.A.	88.5	1,901
1909	89,189	N.A.	N.A.	9,275	127,995	116,115	19.23	0.6968	N.A.	90.0	1,982
1910	89,728	N.A.	N.A.	9,295	128,271	116,365	19.31	0.6995	N.A.	91.5	1,961
1911	87,183	N.A.	N.A.	9,020	124,476	112,922	19.33	0.7004	N.A.	93.0	1,875
1912	89,491	N.A.	N.A.	9,330	128,754	116,803	19.18	0.6951	N.A.	94.5	1,894
1913	88,128	N.A.	N.A.	9,170	126,546	114,800	19.22	0.6964	N.A.	96.0	1,836
1914	83,126	N.A.	N.A.	8,565	118,197	107,226	19.41	0.7033	N.A.	97.6	1,703
1915	78,217	N.A.	N.A.	8,020	110,676	100,403	19.51	0.7067	N.A.	99.1	1,579
1916	82,596	N.A.	N.A.	8,530	117,714	106,788	19.37	0.7017	N.A.	100.6	1,642
1917	77,640	N.A.	N.A.	7,940	109,572	99,402	19.56	0.7086	N.A.	102.1	1,521
1918	73,469	N.A.	N.A.	7,310	100,878	91,515	20.10	0.7283	N.A.	103.6	1,418
1919	76,701	N.A.	N.A.	7,725	106,605	96,710	19.86	0.7195	N.A.	105.1	1,460
1920	78,087	N.A.	N.A.	7,790	107,502	97,524	20.05	0.7264	N.A.	106.8	1,462
1921	66,263	N.A.	N.A.	6,580	90,804	82,376	20.14	0.7297	N.A.	108.4	1,223
1922	74,098	N.A.	N.A.	7,605	104,949	95,208	19.49	0.7060	N.A.	110.1	1,346
1923	81,991	N.A.	N.A.	8,545	117,921	106,976	19.19	0.6953	N.A.	111.8	1,467
1924	79,892	N.A.	N.A.	8,260	113,988	103,408	19.34	0.7009	N.A.	113.5	1,408
1925	79,724	N.A.	N.A.	8,380	115,644	104,910	19.03	0.6894	N.A.	115.1	1,385
1926	79,242	N.A.	N.A.	8,225	113,505	102,969	19.27	0.6981	N.A.	116.8	1,357
1927	75,924	N.A.	N.A.	7,805	107,709	97,711	19.46	0.7049	N.A.	118.5	1,281
1928	74,766	N.A.	N.A.	7,690	106,122	96,272	19.44	0.7045	N.A.	120.1	1,245
1929	78,295	N.A.	N.A.	8,050	111,090	100,779	19.45	0.7048	N.A.	121.8	1,286
1930	63,659	N.A.	N.A.	6,345	87,561	79,434	20.07	0.7270	N.A.	122.7	1,038
1931	48,444	N.A.	N.A.	4,625	63,825	57,901	20.95	0.7590	N.A.	123.7	783
1932	37,424	N.A.	N.A.	3,395	46,851	42,502	22.05	0.7988	N.A.	124.6	601
1933	42,751	N.A.	N.A.	4,045	55,821	50,640	21.14	0.7659	N.A.	125.6	681
1934	45,361	N.A.	N.A.	4,355	60,099	54,521	20.83	0.7548	N.A.	126.5	717
1935	51,799	N.A.	N.A.	5,095	70,311	63,785	20.33	0.7367	N.A.	127.4	813
1936	59,991	N.A.	N.A.	5,990	82,662	74,989	20.03	0.7257	N.A.	128.3	935
1937	63,206	N.A.	N.A.	6,370	87,906	79,747	19.84	0.7190	N.A.	129.2	978
1938	55,346	N.A.	N.A.	5,570	76,866	69,731	19.87	0.72 0	N.A.	130.1	851
1939	62,743	N.A.	N.A.	6,375	87,975	79,809	19.68	0.7132	N.A.	131.0	958
1940	66,300	N.A.	N.A.	6,975	96,255	87,321	19.01	0.6888	N.A.	132.6	1,000

Table 3—Total production, productivity, recovered paper utilization, and per capita production^a—con.

Year	Total industrial wood product production (thousand tons)	Roundwood equivalents of production ^b					Industrial wood productivity (industrial wood product output per unit of roundwood input)		Recovered paper utilization rate ^c	U.S. population (millions)	Per capita industrial wood product production (lb/capita)
		Hardwoods (million ft ³)	Softwoods (million ft ³)	Total							
				(million ft ³)	(thousand short tons)	(thousand metric tons)					
1941	77,432	N.A.	N.A.	8,050	111,090	100,779	19.24	0.6970	N.A.	134.2	1,154
1942	76,567	N.A.	N.A.	8,085	111,573	101,217	18.94	0.6863	N.A.	135.7	1,128
1943	73,371	N.A.	N.A.	7,560	104,328	94,644	19.41	0.7033	N.A.	137.3	1,069
1944	72,213	N.A.	N.A.	7,455	102,879	93,330	19.37	0.7019	N.A.	138.9	1,040
1945	65,963	N.A.	N.A.	6,605	91,149	82,689	19.97	0.7237	N.A.	141.1	935
1946	75,422	N.A.	N.A.	7,705	106,329	96,460	19.58	0.7093	N.A.	143.2	1,053
1947	79,140	N.A.	N.A.	8,090	111,642	101,279	19.56	0.7089	N.A.	145.4	1,089
1948	80,181	N.A.	N.A.	8,365	115,437	104,722	19.17	0.6946	N.A.	147.5	1,087
1949	70,383	N.A.	N.A.	7,340	101,292	91,890	19.18	0.6949	N.A.	149.7	940
1950	82,814	1,910	6,610	8,520	117,605	106,689	19.44	0.7042	33.2%	152.4	1,087
1951	83,472	2,045	6,685	8,730	120,778	109,568	19.12	0.6911	35.3%	155.0	1,077
1952	81,464	1,930	6,830	8,765	120,813	109,599	18.59	0.6743	32.8%	157.7	1,033
1953	84,182	1,945	6,825	8,770	120,990	109,760	19.20	0.6958	32.6%	160.3	1,050
1954	83,469	1,940	6,790	8,730	120,451	109,270	19.12	0.6930	30.5%	163.0	1,024
1955	90,273	2,080	7,115	9,195	126,981	115,195	19.64	0.7109	30.5%	166.0	1,088
1956	91,858	2,180	7,415	9,590	132,534	120,233	19.16	0.6931	28.6%	168.9	1,088
1957	86,501	1,815	6,775	8,590	118,226	107,252	20.14	0.7317	30.0%	171.9	1,006
1958	87,827	1,790	6,710	8,500	116,969	106,112	20.67	0.7509	28.7%	174.8	1,005
1959	97,302	2,005	7,350	9,355	128,844	116,884	20.80	0.7552	27.9%	177.8	1,095
1960	88,651	1,985	6,895	8,875	122,557	111,181	19.98	0.7233	26.6%	180.6	982
1961	88,943	1,925	6,745	8,665	119,618	108,515	20.53	0.7436	24.9%	183.4	970
1962	92,674	2,040	6,910	8,950	123,646	112,169	20.71	0.7495	24.5%	186.3	995
1963	98,468	2,215	7,190	9,410	130,154	118,073	20.93	0.7565	24.9%	189.1	1,041
1964	104,539	2,340	7,660	10,000	138,341	125,500	20.91	0.7557	24.0%	191.9	1,090
1965	108,836	2,936	8,139	11,042	154,283	139,962	19.71	0.7054	23.5%	194.3	1,120
1966	113,172	3,084	8,250	11,303	158,133	143,455	20.03	0.7157	22.6%	196.6	1,151
1967	110,978	2,921	8,123	11,022	153,841	139,561	20.14	0.7214	21.2%	198.7	1,117
1968	115,475	2,806	8,683	11,472	159,313	144,525	20.13	0.7248	20.4%	200.7	1,151
1969	116,083	2,812	8,521	11,288	157,283	142,684	20.57	0.7381	22.1%	202.7	1,145
1970	114,690	2,672	8,622	11,273	156,343	141,832	20.35	0.7336	22.8%	205.1	1,118
1971	120,765	2,785	8,924	11,695	162,113	147,066	20.65	0.7449	22.8%	207.7	1,163
1972	128,245	2,870	9,045	11,915	165,093	149,769	21.53	0.7768	22.5%	209.9	1,222
1973	132,862	3,075	9,130	12,175	169,536	153,800	21.83	0.7837	23.5%	211.9	1,254
1974	125,754	3,072	8,649	11,720	163,174	148,028	21.46	0.7707	23.7%	213.9	1,176
1975	113,613	2,478	7,896	10,392	143,660	130,326	21.87	0.7908	23.0%	216.0	1,052
1976	127,309	2,725	8,955	11,712	161,554	146,558	21.74	0.7880	23.4%	218.0	1,168
1977	133,938	2,837	9,269	12,125	167,483	151,938	22.09	0.7997	23.4%	220.2	1,217
1978	137,448	3,021	9,436	12,374	172,662	156,636	22.22	0.7961	23.8%	222.6	1,235
1979	139,644	3,120	9,520	12,625	175,367	159,090	22.12	0.7963	23.9%	225.1	1,241
1980	131,621	3,038	8,648	11,627	162,615	147,521	22.64	0.8094	23.5%	227.7	1,156

Table 3—Total production, productivity, recovered paper utilization, and per capita production^a—con.

Year	Total industrial wood product production (thousand tons)	Roundwood equivalents of production ^b					Industrial wood productivity (industrial wood product output per unit of roundwood input)		Recovered paper utilization rate ^c	U.S. population (millions)	Per capita industrial wood product production (lb/capita)
		Hardwoods (million ft ³)	Softwoods (million ft ³)	Total							
				(million ft ³)	(thousand short tons)	(thousand metric tons)	(lb/ft ³)	(tons/ton)			
1981	128,025	2,908	8,187	11,017	154,453	140,117	23.24	0.8289	23.4%	230.0	1,113
1982	123,611	2,884	7,936	10,770	150,775	136,780	22.95	0.8198	23.7%	232.2	1,065
1983	141,352	3,322	9,029	12,308	172,216	156,231	22.97	0.8208	23.4%	234.3	1,207
1984	149,536	3,569	9,177	12,785	178,155	161,619	23.39	0.8394	23.8%	236.3	1,266
1985	147,441	3,543	9,132	12,675	177,140	160,698	23.26	0.8323	23.8%	238.5	1,236
1986	161,325	4,118	10,029	14,147	198,230	179,830	22.81	0.8138	24.7%	240.7	1,340
1987	170,910	4,221	10,617	14,826	207,604	188,334	23.06	0.8232	24.6%	242.8	1,408
1988	175,234	4,395	10,553	14,948	209,591	190,137	23.45	0.8361	25.1%	245.0	1,430
1989	174,961	4,490	10,297	14,720	207,769	188,484	23.77	0.8421	25.7%	247.3	1,415
1990	175,186	4,546	10,155	14,607	206,830	187,632	23.99	0.8470	27.0%	249.9	1,402
1991	170,541	4,386	9,689	13,969	198,116	179,727	24.42	0.8608	29.1%	252.6	1,350
1992	177,418	4,529	9,949	14,292	203,855	184,934	24.83	0.8703	30.9%	255.4	1,389
1993	178,069	4,667	9,539	13,986	200,720	182,089	25.46	0.8872	32.3%	258.1	1,380
1994	185,192	4,805	9,744	14,354	205,648	186,560	25.80	0.9005	33.7%	260.7	1,421
1995	184,810	4,991	9,620	14,455	207,038	187,821	25.57	0.8926	34.4%	263.2	1,404
1996	187,038	4,931	9,677	14,344	206,805	187,609	26.08	0.9044	36.9%	265.6	1,408
1997	193,616	5,075	9,586	14,852	207,948	188,646	26.07	0.9311	37.4%	266.5	1,453
1998	194,180	5,031	9,821	14,852	210,317	190,796	26.15	0.9233	37.9%	268.8	1,445

^aN.A., data or estimates not available for given data series.

^bFrom Hair (1958), Howard (1997), and Ulrich (1985).

^cThe recovered paper utilization rate has been published annually by the American Forest & Paper Association based on industry surveys (AF&PA 1999b).

Table 4—Conversion factor assumptions (conventional units to thousands of short tons)

	Softwood plywood	OSB/wafer-board	Laminated veneer lumber	Hardwood plywood and veneer	Softwood lumber	Hardwood lumber	Lumber made at pallet plants	Particle-board production	Hardboard production	MDF production	Pulp, Paper, and board	Other industrial products	Insulating board
Conventional units	million ft ² , 3/8 in.	million ft ² , 3/8 in.	million ft ³	million ft ² , 3/8 in.	million bd. ft.	million bd. ft.	million bd. ft.	million ft ² , 3/4 in.	million ft ² , 1/8 in.	million ft ² , 3/4 in.	thousand tons	million ft ³	million ft ² , 1/2 in.
Conversion factor to tons	0.547	0.625	17.500	0.656	0.976	1.688	1.667	1.406	0.313	1.406	1	16.500	0.367
Assumption	35.0 lb/ft ³	40.0 lb/ft ³	35.0 lb/ft ³	42.0 lb/ft ³	33.0 lb/ft ³ solid	40.5 lb/ft ³ solid	40.0 lb/ft ³ solid	45.0 lb/ft ³	60.0 lb/ft ³	45.0 lb/ft ³		33.0 lb/ft ³	23.5 lb/ft ³

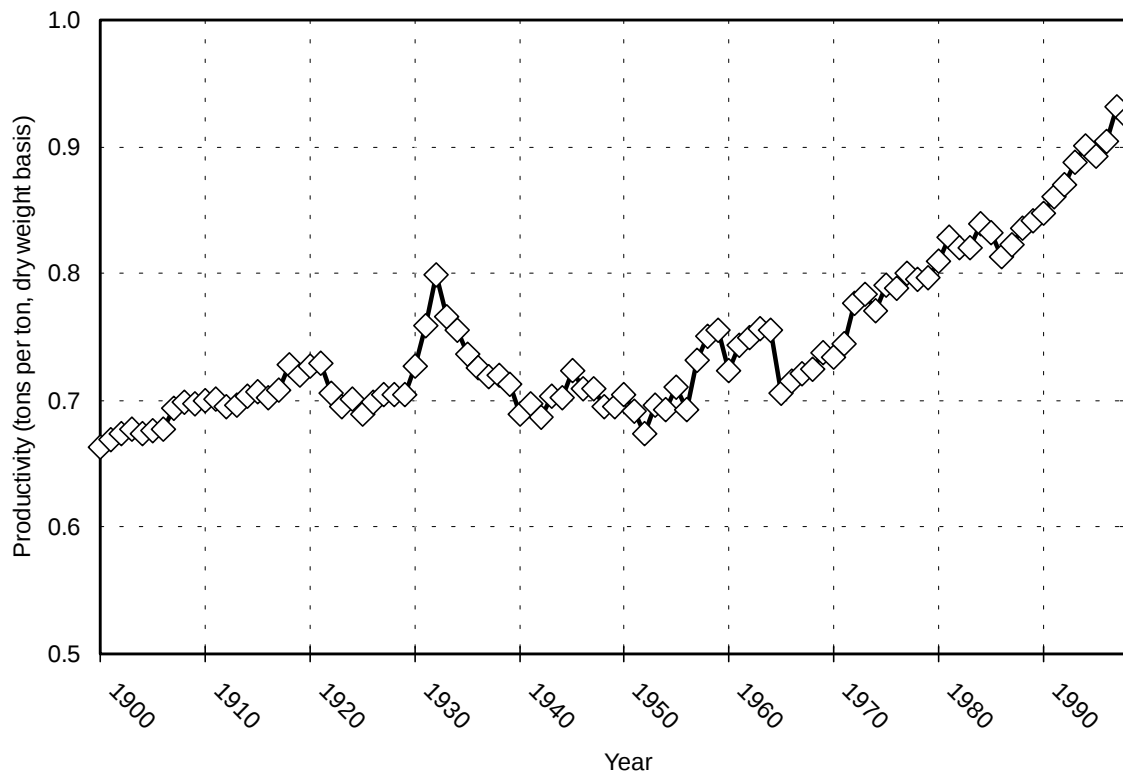


Figure 1—U.S. industrial wood productivity—tons of industrial wood product output per ton of industrial roundwood input, 1900 to 1998 (USDA Forest Service).

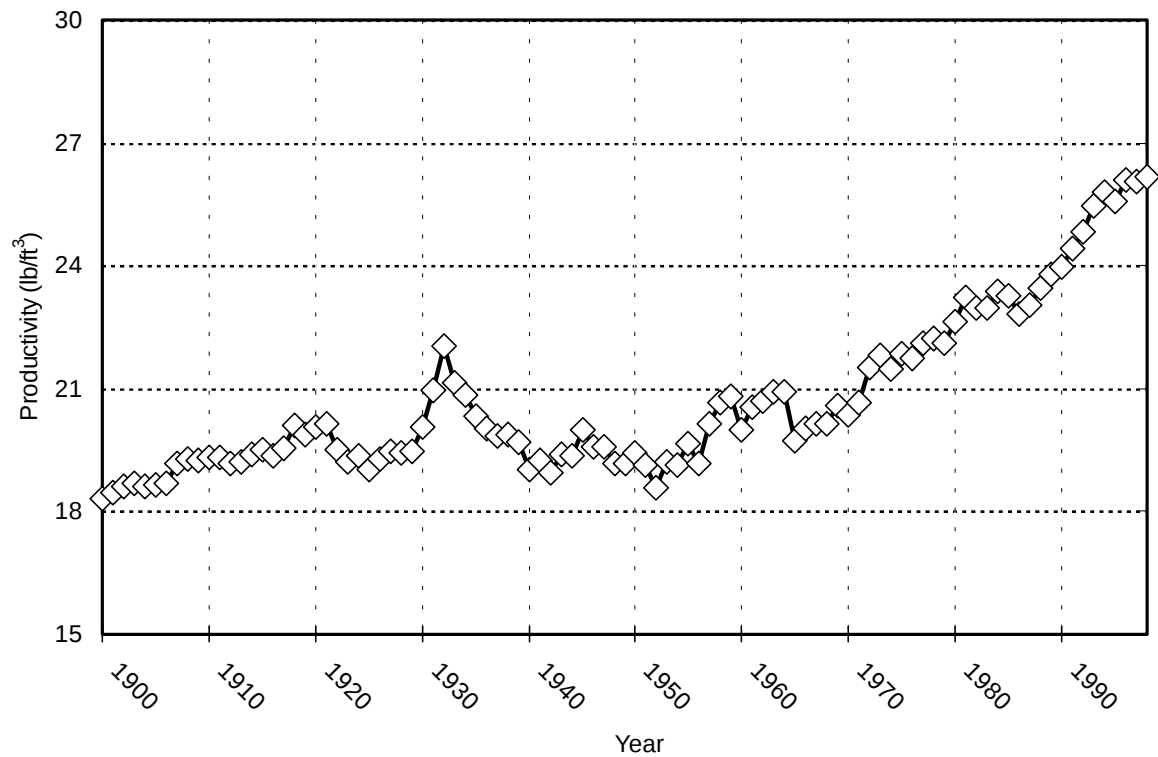


Figure 2—U.S. industrial wood productivity—pounds of industrial wood product output per cubic foot of industrial roundwood input, 1900 to 1998 (USDA Forest Service).

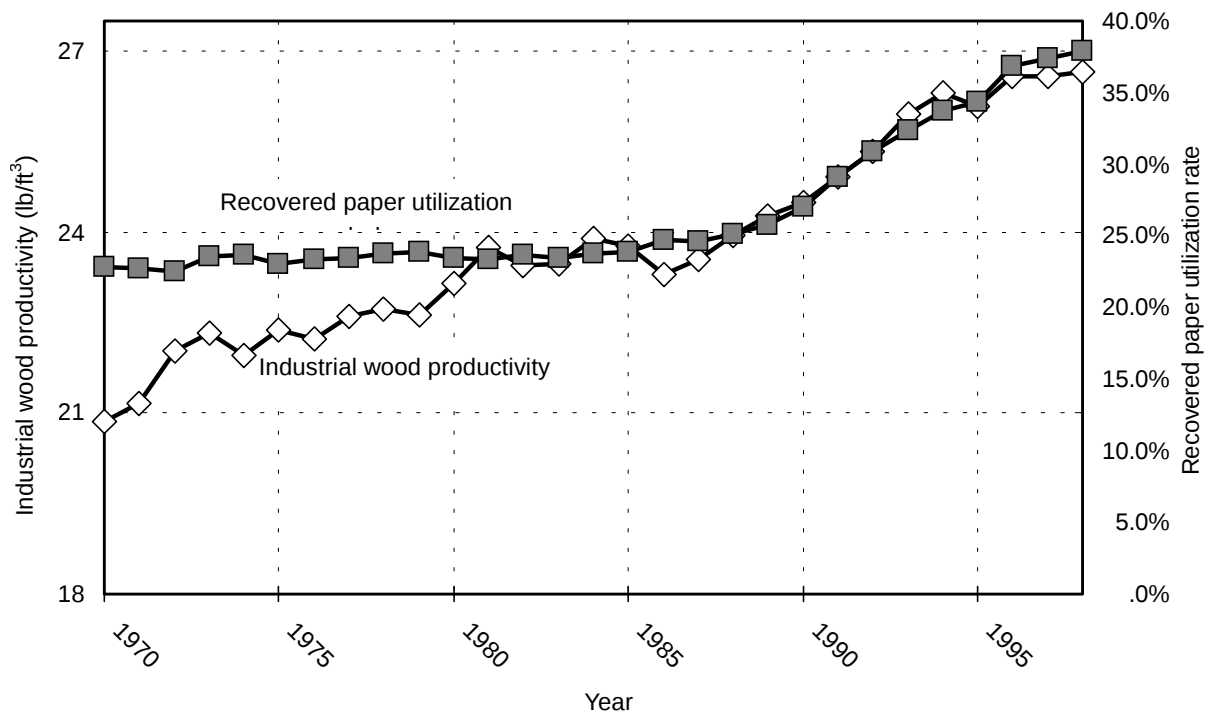


Figure 3—U.S. industrial wood productivity (USDA Forest Service) and recovered paper utilization rates (AF&PA), 1970 to 1998.

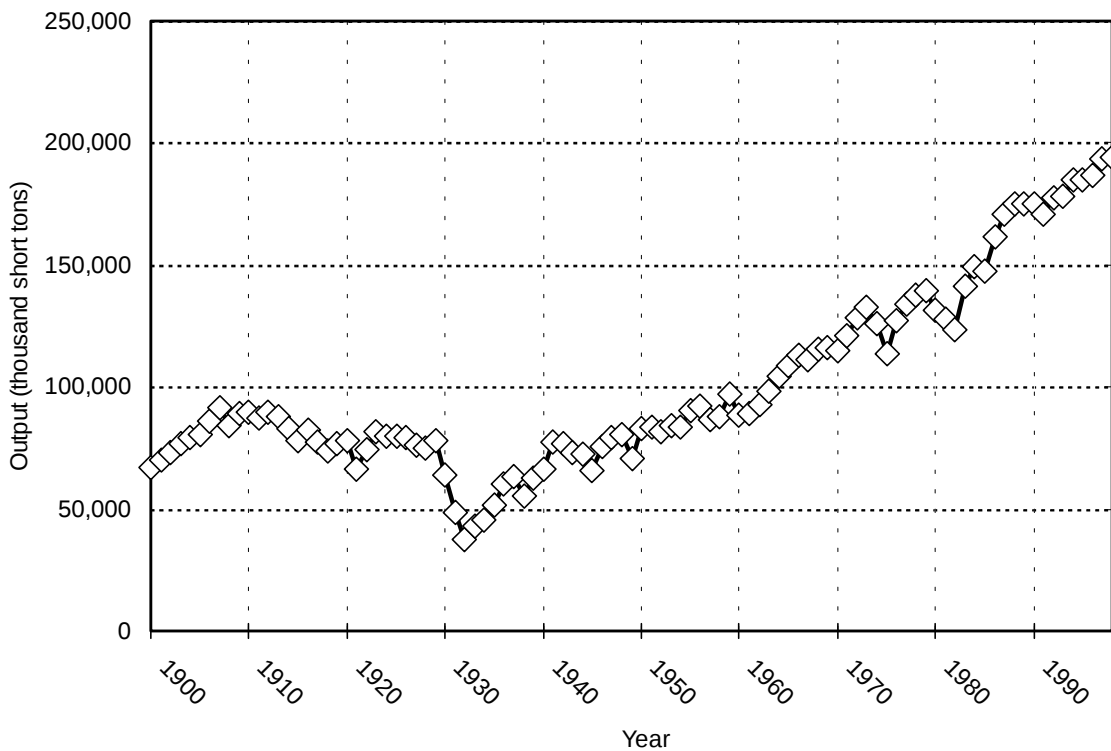


Figure 4—U.S. industrial wood product output, 1900 to 1998 (USDA Forest Service, Forest Products Laboratory).

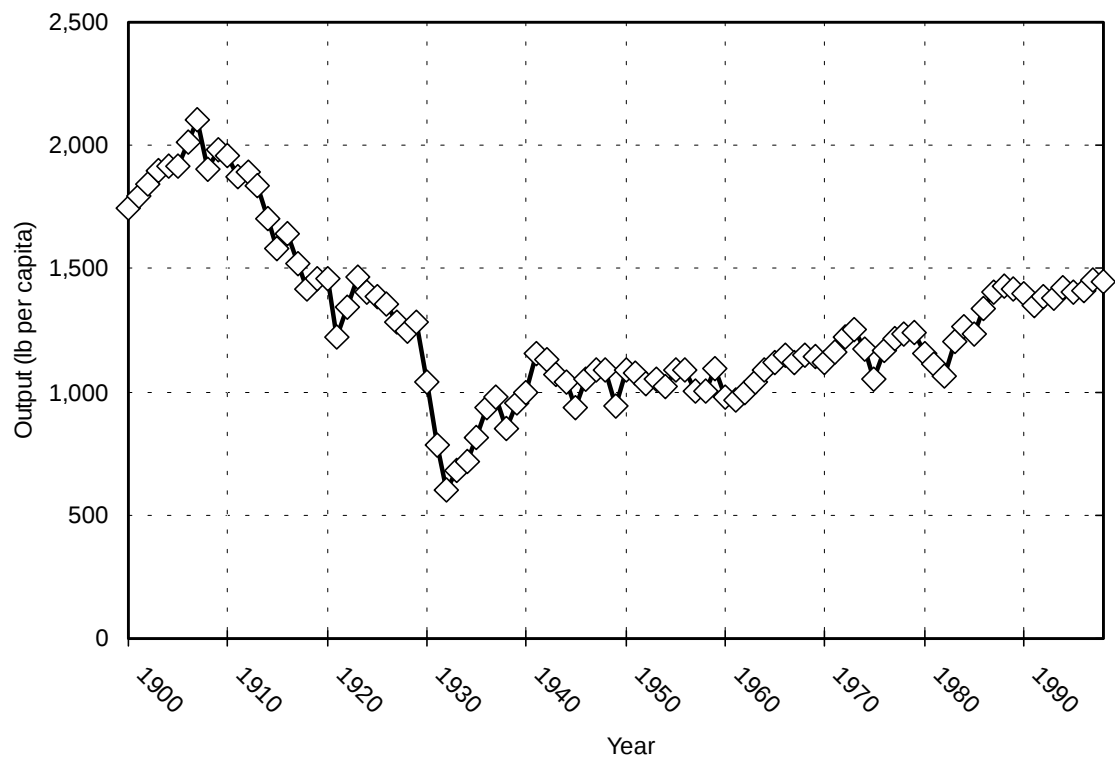


Figure 5—U.S. per capita industrial wood product output in pounds per capita, 1900 to 1998 (USDA Forest Service, Forest Products Laboratory).